

Report

Quality Assurance Project Plan (QAPP)
For
Remedial Investigation/Feasibility Study
Dallas Housing Authority
Operable Unit 02
January 1994

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Q-94-049

**Quality Assurance Project Plan (QAPP)
For
Remedial Investigation/Feasibility Study
Dallas Housing Authority
Operable Unit 02
January 1994**

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**Prepared by:
Camp Dresser & McKee Inc.
12770 Coit Road, Suite 800
Dallas, Texas 75251**

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Section 1

Project Objectives

The objectives of the DHA Project being conducted by CDM are to:

- Determine the nature and extent of contamination resulting from activities associated with the lead smelting, metal fabricating, and battery wrecking operations in the vicinity of the West Dallas Development;
- Advise the DHA on how to respond to contamination in the short-term;
- Develop an overall plan on how to address contamination over the long-term;
- Perform appropriate risk assessments based on site investigation results and determine appropriate remedial activities;
- Perform all activities and present all findings and associated reports in a form consistent with the Administrative Order on Consent (AOC); and
- Implement Work Plan to perform appropriate remedial activities.

The major priorities of the site investigation concern:

- The personal health and safety of residents at the site;
- The personal health and safety of workers disturbing soil during construction; and
- The potential hazards of long term demolition and construction at the site.

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Project Team Organization

The team CDM has selected for this project provides DHA with technical and managerial experience from similar projects around the United States. The project team is organized as shown in Figure 2-1. Staff selection for this project focuses on individuals with appropriate RI/FS experience. Senior technical personnel will oversee this operation providing guidance and insight into potential future litigation support requirements.

Chuck McLendon has been identified as the CDM Project Manager. Senior technical reviewers will include Mike Tilly, Kathleen Gill and Jennifer Alai under the direction of Roger Olsen. The Quality Assurance Manager is Dr. Rick Chappell.

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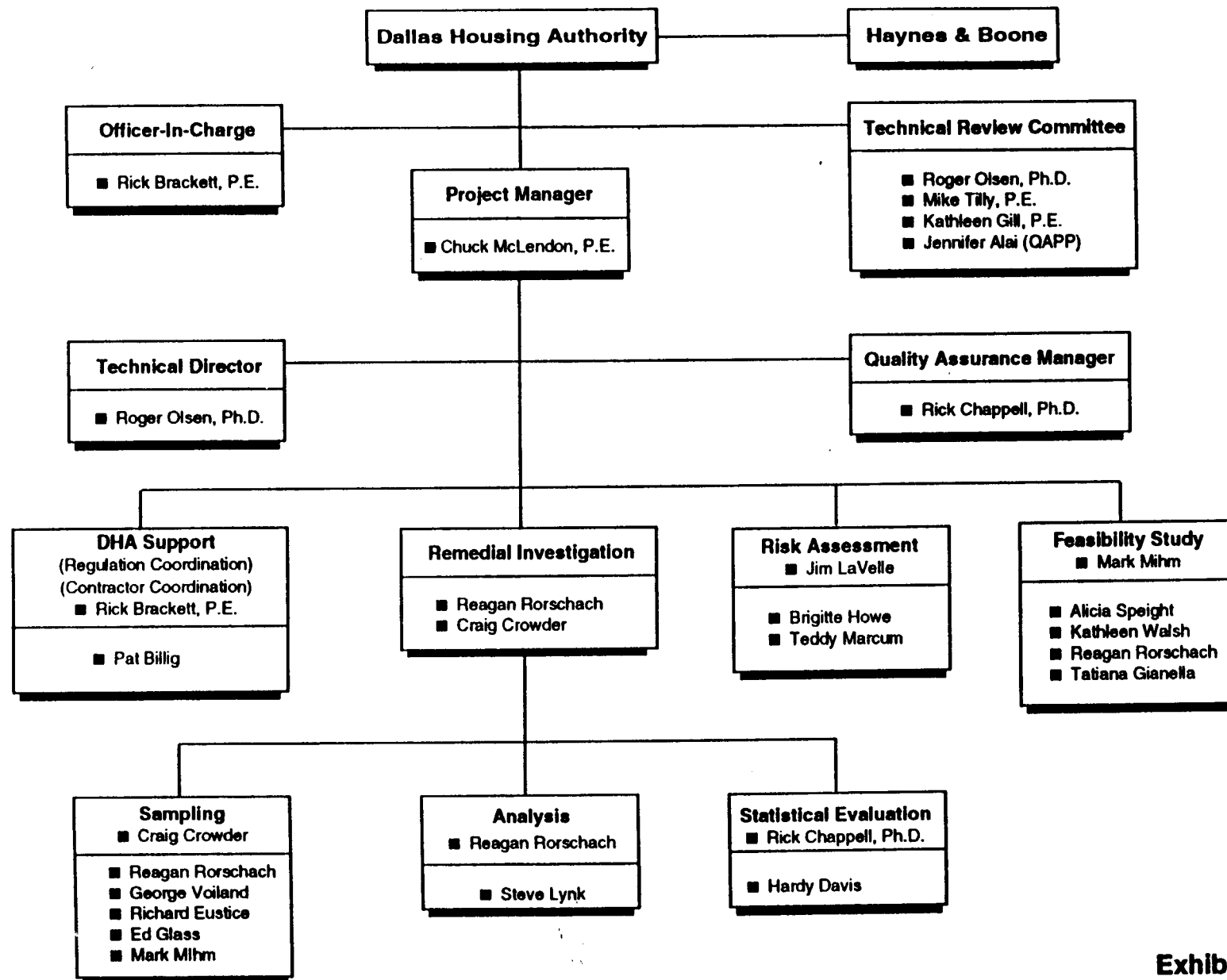


Exhibit 2-1
DHA RI/FS QAPP
Personnel and Activities

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Field Equipment Operation, Maintenance, Calibration and Standardization

Field equipment used during the RI/FS field sampling will be operated, maintained, calibrated, and standardized in accordance with manufacturer and where applicable, EPA specifications. Each piece of field equipment will have a protocol package that contains, as appropriate, the following:

- Standard operating procedures;
- Routine preventative maintenance procedures including a list of critical spare parts to be available in the field;
- Calibration methods, frequency, and description of calibration solutions;
- Standardization procedures (treatability to known standards); and
- Precision and accuracy assessment procedures.

Reliability of environmental measurements will be based upon sound calibration procedures for the analytical equipment. Frequent calibration checking will ensure continued reliability. All field and laboratory measurements must be made relative to known standards.

Field Monitoring Equipment

During the conduct of field activities related to the DHA RI, the following field measurements are expected to be performed when collecting soil and groundwater samples:

- pH
- Specific Conductance
- Temperature
- Organic Vapor Levels
- Depth to Water Table

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The equipment used to obtain these measurements will be operated, maintained, calibrated, and standardized as described in the following:

Field Screening of Liquids

Field measurements of temperature, pH, and conductivity will be taken on all liquid (groundwater) samples. Measurements will be made using a combination pH, conductivity, and temperature meter.

Two replicate measurements will be made on each water sample for temperature, pH, and conductivity. Measurements will be made immediately upon recovery of the sample from the pump discharge line or bailer. The instrument probe tip will be rinsed in deionized water between measurements.

Temperature will be measured first; pH will be measured second. Conductivity will be measured third.

Measurements will also be taken of groundwater during development of wells prior to sampling. Procedures will be the same as for measurements of samples except that replicate measurements will not be required.

The calibration of the pH and conductivity probes associated with the meter will be as follows:

The pH meter will be calibrated daily using standards for pH = 4.0 and 7.0, respectively. The manufacturer's recommended calibration procedures including warm-up time, temperature setting, and battery check will be followed and documented in the field log book. Calibration shall be completed prior to commencing field activities and checked every four hours and between each monitor well and water well location.

Once the sample has been collected, the pH probe will be placed into the sample and the pH recorded into the field log book. After the initial reading, the sample will be swirled by the probe and a second reading will be obtained and recorded.

The probe will be removed and rinsed with deionized water, dried with paper towels, and placed into the deionized water blank for field storage.

The pH meter will be turned off after use, and the battery recharged daily.

Organic Vapor Meter (OVM)

During field activities related to drilling and sampling soils for chemical analysis, the OVM will be used to monitor air in the breathing zones for potentially hazardous organic vapor emissions.

The OVM will be used to detect trace concentrations of certain organic gases and a few inorganic gases in the air. When a 10.2 ev probe is used, the meter

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is most sensitive to aromatic hydrocarbons, aliphatic amines, and unsaturated chlorinated hydrocarbons. Carbonyl and unsaturated hydrocarbons, sulfides, ammonia, and the heavier paraffins (C₅ - C₇) can also be detected but with a lesser degree of sensitivity. Most alkyl halides such as those present in groundwater samples from the site, and low molecular alkanes, are not detected by an OVM equipped with 10.2 ev probe but can be detected by an OVM equipped with an 11.7 probe. The OVM probe selected for this project is the 10.2 ev due to its specificity for the contaminants which may be encountered at the site. The OVM will be calibrated daily according to manufacturers procedures. The battery will be charged overnight at the end of each day of field activities.

The OVM will also be used to screen samples for the presence of organic vapors. The instrument will be calibrated daily to a standard gas prior to use (i.e., methane). All calibration procedures will be recorded in the daily field log. For each day of use for field activities, the following calibration information will be recorded:

- Instrument calibrated (I.D. or serial number)
- Date
- Method of calibration
- Results of calibration
- Identification of person who calibrated instrument
- Identification of the calibration gas (source, type concentration, lot number)

Depth to Water Table Measurements

During the conduct of groundwater assessment activities, the measurement of static groundwater levels in monitor wells is very important. A wire line electronic sounder will be used to obtain water level measurements to the nearest 0.01 feet. Once the water level has been determined, the probe will be retracted and decontaminated prior to utilization in another monitor well. The battery will be checked periodically and replaced as necessary during the conduct of groundwater assessment activities.

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Sampling Procedures

The objectives of sampling procedures and field measurements are to obtain samples and measurements that accurately and precisely represent the environment being investigated. Trace levels of contaminants from external sources must be eliminated through the use of proper sampling techniques, proper sampling equipment, proper decontamination procedures by experienced field personnel.

Field measurements and sampling will be performed in accordance with accepted procedures and as previously discussed. The Sampling Plan and this QAPP for the DHA Site specifies the standard operating procedures to be used during the investigations. The details of the field procedures are provided in Section 3.0 of the Field Sampling Plan. Sample handling and analysis is detailed in Section 5 of the Field Sampling Plan. Sample handling and analysis is detailed in Section 5 of the Field Sampling Plan.

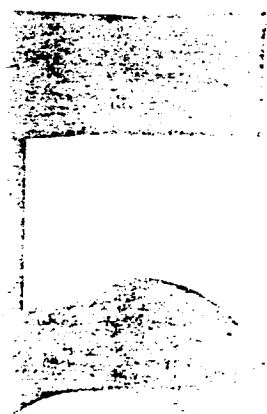
All samples will be sent to Core Laboratories or other designated lab at the following address:

Core Laboratories
1875 Monetary Drive
Carrollton, Texas 75006

All questions or problems regarding the laboratory should be directed to Ed York of Core Labs at (214) 466-2673.

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Analytical Procedures

Soil, ground water, surface water, and sediment samples collected from the DHA site will be analyzed by a non-CLP laboratory. Samples will be sent to the Core Laboratories in Carrollton, Texas or other designated lab. The laboratory will utilize EPA Methods in accordance to the procedures specified in Exhibit 5-1. A CLP analytical package will accompany the data. Split samples will be sent to a CLP laboratory. Additional split samples may be collected by the EPA for CLP analysis. In general, the laboratories utilized during the RI/FS will follow recommendations from the following sourcebooks:

- 40 CFR 792, "Good Laboratory Practices";
- Criteria described in, *"Methods for Chemical Analysis of Water and Wastes"*, 1983 (EPA-600/4-70-020, revised 1983);
- *"Test Methods for the Analysis of Solid Wastes"*, (SW-846, 3rd Ed.);
- "Federal Register, 40 CFR Part 136", October 1984; and
- Where applicable, the requirements of the EPA CLP statement of work for 1993.

Laboratory Analysis & QA/QC Requirements

Soil, ground water, surface water, and water sediment samples collected during the RI/FS will be sent to Core Laboratories for analysis. Split samples will be sent to a CLP laboratory. These laboratories have an approved QA plan in place which describes corrective actions and delineates QA responsibilities within the laboratory. The general practices required of the laboratories are presented below. Specific requirements for the frequency of analysis and control-limits for general QC sample types described below are summarized in Exhibit 5-1.

Purity of Standards, Solvents and Reagents

All reagents will be of reagent-grade or higher quality. Organic solvents are to be pesticide-grade or equivalent. Where applicable, reference standard solutions will be traceable to the EPA or the National Bureau of Standards (NBS). Each new lot of reagent-grade chemicals will be tested for quality of

Exhibit 5-1

**RI/FS QAPP
Analytical Methods, References, and Method Detection Limits**

Dallas Housing Authority

Matrix	Parameter(s)	Sample Prep. Extraction Digest Method	Sample Analysis Method	References	MDL	Comments
Soil	Metals (Pb, As, and Cd)	Acid digest, distillation	Method 6010 (ICP)	U.S. EPA, Test Methods for Evaluating Solid Wastes, SW-846 3rd Ed., 11/86.	1-10 mg/kg	
	Inorganic Target Analyte List (TAL)	1993 SOW Extraction	1993 SOW (ICP, GFAA, CV, etc.)	U.S. EPA CLP Inorganics Statement of Work, ILM03.0	CLP-CRDLs	
	Organic Target Compound List (TCL)	1993 SOW Extraction	1993 SOW (GC/MS, GC/ECD)	U.S. EPA CLP Organics Statement of Work, OLM01.9	CLP-CRDLs	Vinyl Chloride will have a DL of 2 µg/l
	Grain Size Distribution	per Method	ASTM D-2216	American Society for Testing and Materials 1980	1 percent	
	Moisture Content	per Method	ASTM D-2216	American Society for Testing and Materials 1980	1 percent	
	Total Organic Carbon	per Method	Method 9060	U.S. EPA, Test Methods for Evaluating Solid Wastes SW-846 3rd Ed. 11/86	1 mg/kg	
Ground Water²	Inorganic Target Analyte List (TAL)	SOW extraction	SOW	U.S. EPA CLP Inorganics Statement of Work, ILM01.0	CLP-CRDLs	
	Organic Target Compound List (TCL)	SOW extraction	SOW	U.S. EPA CLP Organics Statement of Work, OLM01.9	CLP-CRDLs	Vinyl chloride will have a DL of 2 µg/l
	Total Dissolved Solids (TDS)	per Method	Method 160.1	U.S. EPA, Methods for the Chemical Analysis of Water and Wastes, 3/83	5 mg/l	
	Alkalinity	None	Method 310.1	U.S. EPA, Methods for the Chemical Analysis of Water and Wastes, 3/83	1.0 mg/L	

Exhibit 5-1 (Continued)

Matrix	Parameter(s)	Sample Prep. Extraction Digest Method	Sample Analysis Method	References	MDL	Comments
Surface Water²	Inorganic Target Analyte List (TAL)	SOW Extraction	SOW	U.S. EPA CLP Inorganics Statement of Work 1990, ILM03.0	CLP-CRDLs	
	Organic Target Compound List (TCL)	1993 SOW Extraction	SOW	U.S. EPA CLP Organics Statement of Work 1991, OLM01.9	CLP-CRDLs	Vinyl chloride will have a DL of 2 µg/l
	Alkalinity	Filtered	Method 310.1	U.S. EPA, Methods for the Chemical Analysis of Water and Wastes, 3/83	1.0 mg/l	
	Total Suspended Solids (TSS)	per Method	Method 160.2	U.S. EPA, Methods for the Chemical Analysis Water and Wastes, 3/83	5 mg/L	
	Nitrate/Nitrite	per Method	Method 353.2	U.S. EPA, Test Methods for Evaluating Solid Wastes, SW-846, 3rd Ed., 11/86	0.01 mg/L	
	Kjeldahl Nitrogen	per Method	Method 351.4/ 351.2/351.3	U.S. EPA, Methods for the Chemical Analysis of Water and Wastes, 3/83	0.01 mg/L	
Sediments	Inorganic Target Analyte List (TAL)	SOW Extraction	SOW	U.S. EPA CLP Inorganics Statement of Work, ILM03.0	CLP-CRDLs	
	Organic Target Compound List (TCL)	SOW Extraction	SOW	U.S. EPA CLP Organics Statement of Work, OLM01.9	CLP-CRDLs	Vinyl chloride will have a DL of 2µg/l

NOTE: 1) Ground water also analyzed for Alkalinity, Conductivity, and Total Dissolved Solids (TDS) by Methods 310.1, 120.1, and 160.1; respectively.

2) Surface water also analyzed for Alkalinity, Conductivity, and TDS by Method 310.1, 120.1, and 160.1; respectively.

performance, and laboratory records will be kept to document the results of lot tests. Alternatively, reagent blanks will be prepared from each lot. If method blank contamination is found, the reagent blank will be analyzed to evaluate the source of contamination.

Laboratory "Reagent-Grade" Water

Laboratory pure water is generally prepared by a special deionized water system augmented by individual filter cartridges and polishers located at each outlet point. The polishers include special particulate filters, organic resins, and inorganic resins. Distilled/deionized water may also be used. Laboratory water will be tested so as to demonstrate that it is free of contaminants at levels below the detection limits for the applicable analytical procedures.

Method Blank/Reagent Blank

A laboratory pure water blank will be analyzed along with the aqueous and nonaqueous samples submitted for analyses. The method/reagent blank is processed through all procedures, materials, reagents, and labware used for sample preparation and analysis. The frequency for method blank preparation and analysis is a minimum of one per 20 field samples or per analytical batch, whichever is most frequent. An "analytical batch" is defined as samples which are analyzed together with the same method sequence, the same reagent lots and with the manipulations common to each sample within the same time period or in continuous sequential time periods. Samples in each batch are to be of similar composition or matrix.

For a liquid sample, an empty container is carried through all preparation and analysis procedures to provide method blank data.

Calibration Standards

The calibration standards are prepared in the laboratory by dissolving a known amount of pure (nominally 100%) analyte in an appropriate matrix. The final concentration calculated from the known quantity is the true value of the standards. All calibration standards must be traceable to certified reference materials or certified check standards. The results obtained from these standards are used to generate a standard curve which can be used to quantify the compound in the environmental sample. A minimum of three calibration standards and a blank will be used in generating a standard curve for all analyses. Specific requirements are outlined in the EPA CLP Inorganics and Organics Statements of Work (3/90) and other applicable methods as referenced. For gas chromatography/mass spectrometry analysis, an instrument tune-up must be performed using the standard materials and following criteria, as specified in the organics statement of work.

Check Standard

The check standard is prepared in the same manner as a calibration standard. The final concentration calculated from the known quantity is the true value of the standard. The check standard is not carried through the same process used for the environmental samples, since it does not undergo the sample preparation procedure. The check standard result is used to monitor the continuing validity of an existing calibration curve or concentration calibration standard file. The "check standards" are identified by the CLP as the "continuing calibration verification standards".

The check standard can provide information on the accuracy of instrument performance and response consistency independent of various sample matrices and of the sample preparation procedure. Check standards are analyzed at a minimum frequency of 10 percent. Specific requirements and procedures for calibration and check standards are outlined in the CLP Statement of Work documents. Procedures for calibration and check standards are also outlined in the non-CLP methods (i.e., SW-846). Laboratories will be required to follow all method-specific QC requirements. Corrective actions as specified for calibration checks standards in the CLP Statement of Work will apply to all types of analysis performed.

To verify the accuracy of the analytical system at the low concentration end of the calibration curve, a second type of check standard is prepared at a concentration of two times to five times the instrument detection limit and analyzed at the beginning (after calibration) and end of the day or analytical "run".

Quality Control Check Samples

The QC Check Sample is a reference standard acquired from an EPA approved source (e.g., EPA Standards Repository, NBS) that is analyzed "as is" or diluted according to instructions provided with the reference material, to provide independent verification of instrument calibration.

Quality control check samples for most types of analyses are available from EPA Cincinnati free of charge, and provided to CLP laboratories by the Environmental Monitoring and Support Laboratory/Las Vegas, and will be used at a specific frequency as a means of evaluating the analytical techniques. It is analogous to the "initial calibration verification standard" in the inorganics statement of work. The QC check sample analysis is to be performed in conjunction with organics analyses as well.

Quality control check samples will be analyzed at the frequency specified in the referenced protocols or at a minimum of each time a new calibration curve is established. Corrective action in the form of re-analysis of all associated samples is required if a QC check sample is outside control limits. The control limits are typically a recovery of ± 10 percent of the true value except when the established limits provided by the supplier of the standard reference

materials are different. Documentation of the source and the applicable control limits must be provided with the data.

Control Samples

The Laboratory Control Sample or Method Control Sample is a QC sample (i.e., reference standard) that is carried along with the samples through the entire sample pre-analysis sequence. The true values of these performance evaluation samples is unknown to the laboratory. The frequency for the inclusion of control samples is one per every 20 samples or as stated in the referenced protocols.

Spikes

A sample matrix spike is prepared by adding a known amount of the pure analyte to the environmental sample before extraction/digestion. The added analyte is the same as that being assayed in the environmental sample.

An analytical spike is prepared by adding a known amount of analyte(s) to a known amount of sample extract. For organics analyses, every sample is spiked before extraction/analysis with a surrogate mixture of compounds which are considered to behave similarly during analysis, but are not identical to analytes potentially found in naturally-occurring sample matrices.

Background and interferences having an effect on the actual sample analyte will have a similar effect on the spike. The calculated percent recovery of the matrix spike is considered to be a measure of the relative accuracy of the total analytical method (i.e., sample preparation and analysis). The calculated percent recovery of the analytical spike is considered to be a measure of the relative accuracy of the sample analysis procedure only. The matrix spike, the surrogate spike, and the analytical spike are also measures of the effect of the sample matrix on the ability of the methodology to detect specific analytes. When there is no change in volume due to the spike, the percent recovery is calculated as follows:

$$\%R = 100(A-X)/T$$

Where: %R = Percent Recovery
 A = Measured value of analyte after spike is added
 X = Measured value of analyte concentration in the sample
 before the spike is added
 T = Value of spike

Project-specific QC acceptance limits may be established on a parameter-specific basis for each analytical method, if after sufficient data have been compiled, it is apparent that different limits than those specified in the reference methodology should be applied.

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Matrix spikes will be analyzed at a minimum frequency of one per 20 samples of similar matrix of analytical batch. Analytical spikes and surrogate spikes are required for every sample for some analysis routines (see CLP Statement of Work and Exhibit 5-2).

Matrix Spike Duplicate

For organic analyses, matrix spike duplicate samples are required at a specific frequency of one per 20 samples. A matrix spike duplicate is prepared from a second aliquot of the sample that will be analyzed as the matrix spike. The duplicate relative percent different value between the matrix spilt and the matrix spike duplicate for each spike analyte must be reported. The relative percent difference control limits are defined in the CLP statement of work and vary by analyte.

Laboratory Duplicate Sample

Aliquots (e.g., subsamples) are made in the laboratory of the same sample, and each aliquot is treated exactly the same throughout the analytical method. The relative percent difference (RPD) between the values of the duplicates, as calculated below, is taken as a measure of the precision (reproductibility) of the analytical method:

$$RPD = (D_1 - D_2) / [(D_1 + D_2) / 2] \times 100$$

D_1 = First Sample Value

D_2 = Second Sample Value (Duplicate)

The duplicate is a measure of the precision of the laboratory sampling (i.e., aliquoting) and analysis procedure and of the homogeneity of the sample matrix as provided to the laboratory. Laboratory duplicates will be analyzed at a minimum frequency of one per 20 samples or per analytical batch.

ICP Interference Check Sample

To verify inter-element and background correction factors for ICP analysis, the laboratory must analyze and report the results for an ICP Interference Check Sample (ICS) at the beginning and end of each analytical run, or a minimum of twice per eight hours, whichever is more frequent, but not before initial calibration verification. The ICP Interference Check Samples may be obtained from EPA, if available, and analyzed according to the instructions supplied with the ICS. The instructions for preparation and analysis of an a ICS are found in the CLP Inorganics Statement of Work.

Quality Assurance Objectives for Measurement Data

The RI/FS conducted for the DHA site will include sampling and analysis of the soil, ground water, surface water, and sediments. No air sampling by

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Exhibit 5-2

**RI/FS QAPP
QC Sample Analysis Frequency and Control Limits**

Dallas Housing Authority

Parameters(s)	Matrix	Method Blank		Duplicate Sample		Matrix Spike Sample*		Method Control Sample		Surrogate Samples	
		Control Limit	Minimum Frequency	Control Limit (RPD)	Minimum Frequency	Control Limit (%R)	Minimum Frequency	Control Limit (%R)	Minimum Frequency	Control Limit (%R)	Minimum Frequency
Volatile Organic Compounds (TCL) (10%)	Soil, Ground Water, Surface Water and Sediments	Less than MDL	1 per 20 samples	+/- 35 for MS/MSD	1 per 20 samples	40-150	1 per 20 samples	50-130	1 per 20 samples	50-140	Each Sample
Semi-Volatile Organic Compounds (TCL) (10%)	Soil, Ground Water, Surface Water and Sediments	Less than MDL	1 per 20 samples	+/- 35 for MS/MSD	1 per 20 samples	40-150	1 per 20 samples	50-130	1 per 20 samples	50-130	Each Sample
Priority Pollutant Metals (10%)	Soil, Ground Water, Surface Water, and Sediments	Less than MDL	1 per 20 samples	+/- 20	1 per 20 samples	75-125	1 per 20 samples	80-120	1 per 20 samples	N/A	N/A

N/A - Not Applicable

RPD - Relative percent difference

MDL - Method detection limit

*Includes MS Duplicate Samples for organic analyses.

CDM will be conducted during the RI/FS. CDM will, however, review data generated by the City of Dallas. The overall QA objective for measurement data is to ensure that the data generated is of documented quality and is legally defensible for the intended data uses. In order to meet these objectives, data will be: (1) representative of actual site physical and chemical conditions; (2) comparable to previous and subsequent data from other studies; (3) complete to the extent that necessary conclusions may be reached; and (4) of known quantitative statistical significance in terms of precision and accuracy at levels appropriate for each stated data use for the project. Quantitative limits will be established for QA objectives such as accuracy of spikes and reference compounds, precision, and method detection limits (MDLs).

Quality assurance objectives for measurement data are usually expressed in terms of precision, accuracy, representativeness, completeness, and comparability (also known as the PARCC parameters). Descriptions of these parameters are provided in the following paragraphs.

Precision

Precision is a measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision is represented by percent difference, relative percent difference, and relative standard deviation.

Precision of reported results is a function of inherent field-related variability plus laboratory analytical variability. Various measures of precision exist depending upon "prescribed similar conditions". Field duplicates will be collected at a frequency of 1 per 20 samples. Laboratory travel or trip blanks and laboratory preparation blanks will each have a target collection frequency of 1 per 20 samples (or 1 per day, whichever is more frequent) to provide a measure of the contribution to overall variability of field-related and laboratory-related sources. Laboratory duplicate (split) samples will have a target frequency of 1 per 10 samples (10 percent). Contribution of analytical laboratory-related sources to overall variability will also be measured through various laboratory QC samples (matrix spike duplicates, calibration check samples, etc.).

Accuracy

Accuracy is a measure of how close an analytical result is to a true value. A true value is established from a certified concentration based upon many analyses. Accuracy is a measure of the bias in a system and is generally expressed as a percentage of the true value.

Reference samples (blind standards) will be submitted to the laboratory at a target frequency of 1 per 50 samples collected. Analytical performance on these reference samples will provide a measure of the analytical accuracy of

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the laboratory. Internal laboratory QA samples (matrix spikes and duplicates) will also yield accuracy information.

Computer programs are used to report and store analytical data. Entry accuracy is checked by proof-reading all output and comparing against the validated data from the analytical laboratory(ies). Hard copies of the computer data base will be printed and the information will be manually checked against the laboratory form. As each data base entry is checked, it will be highlighted. At the completion of the accuracy check, the hard copy will be filed as a checkpoint to serve as verification of the check.

Representativeness

Representativeness refers to the degree to which data accurately and precisely represent the true value of a characteristic of a population; parameter variations at a sampling point; a process condition; or an environmental condition intended to be characterized.

Representativeness of reported results depends upon a number of considerations including, but not limited to the following:

- Proper monitoring design;
- Selection of appropriate field methodology;
- Proper sample preparation;
- Preservation and handling;
- Selection and execution of appropriate analytical methodology; and
- Proper sample identification and reporting of results.

Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions.

Field and analytical data may be specified at different completeness levels. The completeness criterion should be defined to be consistent with the project Data Quality Objectives (DQOs). In general, a completeness criterion of 90 percent usable data for specified project data uses will be the completeness target for the site investigation.

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Comparability

Comparability refers to the confidence with which one data set can be compared to another. Comparability may be assessed by comparing different sampling methodologies, analytical methodologies, and units of reported data. For example, the XRF data from the site previous investigation will be compared to the data generated from an EPA Methods such as graphite furnace atomic adsorption (AA) during the RI/FS.

Quantitative Limits

Quantitative limits will be established for accuracy of spikes and reference compounds, precision, and MDLs. The control limits for method blanks will be less than the MDL for all analytical methods. The control limits for duplicate samples will be ± 35 relative percent difference or RPD. The control limit for matrix spike and method control samples, with the exception of metal analysis, will be 40 to 150 and 50 to 130 percent recovery, respectively. The percent recovery for metals will be 75 to 125 for matrix spike samples and 80 to 120 for method control samples. The control limit as expressed as percent recovery for surrogate spikes will be 50 to 130 for VOCs and BNAs.

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Quality Control Checks

This section presents quality control checks that will be conducted during the RI/FS to ensure analytical data quality. This includes field quality control samples, and electronic data base quality control.

Field External Quality Control Checks

The following types of QC samples will be collected in the field and shipped to the laboratories along with the other samples. The type and frequency of these field QC samples are also discussed in Section 3.5 of the Sampling Plan. Note regarding "blind" field blanks: The laboratory may not use field blanks for duplicate analyses or for matrix spiking; therefore, since all field blanks must be shipped "blind", it must be specified to the laboratory which particular nonfield blank sample(s) must be used for duplicate and matrix spike analyses.

Blind Decontamination Rinsate Blank

A decontamination rinsate blank will be prepared and submitted for analysis at a target frequency of one per week. This blank will consist of analyte-free water collected by rinsing sampling equipment after equipment decontamination.

Travel Blanks

Travel blanks consist of a set of sample containers filled in a location away from the site with deionized or other analyte-free water taken to the sampling site, and returned along with the field samples to the laboratory without having been opened in the field. This water preferably should be of the same quality as the method blank water used by the laboratory performing the specific analysis. These travel blanks will be handled, transported, and analyzed in the same manner as the samples acquired on a given day. For the purposes of this investigation, two travel/trip blanks will be included in the analyses.

Blind Field Blank

Field blanks are sample bottles filled with analyte free water that are opened in the field and transferred back and forth (three times) between bottles. Blind field blanks will be collected at a minimum frequency of one per week. The

decontamination rinsate blanks will serve as the field blanks during Round 1 of the sampling. If contamination is found in the rinsate blanks, field blanks will also be collected once per week during Round 2 sampling in order to pinpoint the source of the contamination.

Blind Field Duplicates

Field duplicates may be co-located samples within a single sampling location, collected identically and consecutively over a minimum period of time. This type of field duplicate provides a measure of the total system variability (field and laboratory variance) including the variability component resulting from the inherent heterogeneity of the field sources.

A second types of field duplicate, to be collected for soils are split samples which are collected from a homogenized composite of the sample. This type of duplicate does not provide a measure of the component of variability inherent to the source. However, variability of the remainder of the total systems, including the homogenization procedure, will be characterized. Because samples analyzed for volatiles should not be homogenized, duplicates of this type will not be analyzed for VOAs.

Field duplicates will be collected at a minimum frequency of one per week of sampling. Types of field duplicate samples, whether grab or homogenized composite are discussed in the Sampling Plan.

Blind Standard Reference Materials (SRM)/Performance Evaluation (PE) Samples

SRM and PE samples are materials of known composition which have been prepared by, and obtained from EPA-approved sources, and which have undergone multi-laboratory analyses using a standard method. SRM/PE samples provide a measure of analytical performance and analytical method bias (accuracy). SRM/PE samples will be submitted blind to the contract project laboratory at a frequency of 1 per 50 samples as available, as not all analyses are available as SRMs.

Electronic Data Base Quality Control

The analytical data from the laboratory will be electronically downloaded to the quality control database. This transfer will be checked for accuracy by doing an electronic check of the database against the laboratory diskette deliverable. If greater than five percent of entered values are found in error and corrected, an additional 100 percent quality control check will be done. Electronic data bases manipulated by computer programs will have a minimum of five percent of data checked to ensure the programs functioned correctly.



Section
Seven

Section 7

Sampling Custody and Documentation

Sample custody and documentation QA/QC activities will be implemented during the RI. These activities are designed to maintain the custody and integrity of the samples. QA/QC activities will include sample tracking and documentation, site security measures, sample preparation QC, and field audits. These activities are designed to ensure that QA/QC measures are adequately and properly applied during the RI process.

Sample tracking and documentation will involve the use of field log books, sample preparation and tracking log books, field maps, site photography, sample labeling, and chain-of-custody forms. These procedures allow tracking of each sample from the time of collection through the preparation process to receipt by the laboratory.

Field Sampling Operations

Field sampling custody and documentation will include sample log books, log sheets, field maps, site photography, and sample labeling and chain-of custody forms.

Log Books

Each sampling field team leader will use a log book to record all sampling activities. Field log books will be numbered and bound. In the field log books, team leaders will record the date and time of sample collection, the sampling location, the sample identification number, sampling personnel and others present, weather and other conditions at the site, a photographic log, and other pertinent sampling events in chronological order.

The field team leader will use separate, prenumbered and bound log books to record information pertinent to the RI/FS. The task leader will document the major activities of the sampling, along with any additions to or deviations from planned activities. A designated field task leader will document all information concerning sample collection, custody and documentation.

Chain-of-Custody Requirements

The purpose of the chain-of-custody procedures is to document the identity of the sample, and its handling, from its first existence as a sample until

information derived from it is introduced as evidence during legal proceedings. Custody records trace a sample from its collection through all transfers of custody until it is transferred to an analytical laboratory. Internal laboratory records then document the custody of the sample through its final disposition.

A sample is under custody if one or more of the following criteria are met:

- The sample is in the custodian's (sampler, lab personnel, etc.) possession.
- It is in the custodian's view after being in possession.
- It was in the custodian's possession and was locked up to prevent tampering
- It is in a designated secure area.

Sample identification records and custody records to satisfy the requirements of both EPA and the CLP will be used. The National Enforcement Investigations Center (NEIC) Policies and Procedures Manual provides chain-of-custody and document control procedures, and the User's Guide to the Contract Laboratory Program provides documentation requirements established by the CLP. The remainder of this section discusses the chain-of-custody and document control requirements specified in the above documents which are appropriate to the DHA Site. These procedures will be followed. If any deviations occur, appropriate personnel will be notified and deviations will be noted in the field log book.

Field Custody Requirements

Chain-of-custody for samples collected in the field and transported or shipped to laboratories for analysis will be maintained. The field team will have a designated field sample custodian with overall responsibility for sample custody, and for field document control. The custodian will ensure that the sampling teams have and use the appropriate identification and custody records, will resolve custody problems in the field, and will handle the shipment of samples to the analytical laboratories. It is assumed that each analytical laboratory will have an identified sample custodian and document control officer.

Sample Tags

Each collected sample, including duplicates and travel or field blanks, will have a completely filled-in sample tag securely attached to it. Duplicates, sample splits and blanks will be shipped "blind" to the laboratory, but will be assigned a unique identification code in order to facilitate identification of the laboratory results. Sample collection tags will be preprinted to ensure that the required information is provided on each tag. Tags will include the Project Code number, the location of the sampling site (both address and site code), the type of sample and the analyses required, the time of sampling and the

signature of the sampler. The entire reverse side of the tag is available for Remarks. The person who physically collects the sample is the Sampler and will sign the sample tag.

Chain-of-Custody Record Sheets

Custody records will be used for the samples collected at the DHA Site. The multipart carbonless copy forms will be correlated with the sample collection tags; requested information will have the same heading on both. The sampler or sample custodian will complete a Chain-of-Custody Record to accompany each sample shipment from the field to the laboratory.

The custody records will be used for a packaged lot of samples; more than one sample will usually be recorded on one form. More than one custody record sheet may be used for one package, if necessary. Their purpose is to document the transfer of a group of samples traveling together; when the group of samples changes, a new custody record is initiated. The original custody record travels with the samples; the initiator of the record keeps a copy. When custody of the same group of samples changes hands several times, some people will not have a copy of the custody record. This is acceptable as long as the original custody record shows that each person who had received custody has properly relinquished custody.

General use instructions follow:

Using a Two-Part Custody Record Sheet

- The originator fills in all requested information from the sample tags.
- The originator signs in the top left "Relinquished by" box and keeps the copy.
- The original record sheet travels with the samples.
- The person receiving custody checks the sample tag information against the custody record. He also checks sample condition and notes anything unusual under "Comments" on the custody form.
- The person receiving custody signs in the adjacent "Received by" box and keeps the original.
- The Date/Time will be the same for both signatures since custody must be transferred to another person. When samples are shipped via common carrier (e.g., Federal Express), the date/time will not be the same for both signatures.
- When samples are shipped via common carrier, the original travels with the samples and the shipper (e.g., Field Sample Custodian) keeps the copy. The shipper also keeps all shipping papers, bills of lading, etc.

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- In all cases, it must be readily seen that the same person receiving custody has relinquished it to the next custodian.
- If samples are left unattended or a person refuses to sign, this must be documented and explained on the custody record.

Questions/Problems Concerning Custody Records

If a discrepancy between sample tag numbers and custody record listings is found, the person receiving custody should document this and properly store the samples. The samples should not be analyzed until the problem is resolved by contacting the field sample custodian or other designated responsible authority; e.g., the appropriate QA coordinator.

The responsible person receiving custody should attempt to resolve the problem by checking all available information (other markings on sample container, type of sample, etc.). He should then document the situation on the custody record and in his project logbook and notify the appropriate sample custodian by the fastest available means, followed by written notification.

Changes may be written in the "Comments" section of the Custody record and should be initialed and dated. A copy of this record should accompany the written notification to the sample custodian. A complete copy of the documentation of the problem and its resolution should also be provided to the QA coordinator and submitted to the project files.

Custody Seals

Custody seals are narrow strips of adhesive paper used to demonstrate that no tampering has occurred. They may be used on sampling equipment, but they are intended for use on sample transport containers such as sample coolers. The field investigator shall write the date and signature on the seal.

Laboratory Custody Procedures

The CLP laboratories routinely work with CLP custody procedures and will implement them for this work assignment. Non-CLP laboratories will use sample identification records and custody records to satisfy the CLP or equivalent requirements. These requirements are outlined below:

- Upon receipt at the laboratory, each sample shipment will be inspected to assess the condition of the shipping container and the individual samples, and the condition or integrity of the custody seals on a received shipment of samples will be documented at the time of receipt of the laboratory.
- Enclosed chain-of-custody records will be cross-referenced with all the samples in the shipment; these records will be signed by the sample custodian and placed in the project file.

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- Sample custodian will continue the chain-of-custody by assigning a unique laboratory number to each sample on receipt; this number identifies the sample through all further handling.
- Internal log books and records that maintain the chain-of-custody throughout sample preparation and analysis, and data reporting will be kept.

Sample Shipment

Each sample shipped will be packed in accordance with Department of Transportation (DOT) regulations which include documentation requirements. In addition, each sample will be identified with a sample identification tag, and will be listed on the chain-of-custody record completed for each sample shipping container. The field sample custodian will notify the laboratory sample custodian of sample shipment.

Laboratory Procedures

The laboratory procedures followed during the RI/FS are outlined in each of the analytical laboratory's QC manuals. These manuals will be kept at the CDM office in Dallas during the RI/FS.

Security

Several security measures will be implemented during the RI/FS field sampling to maintain the integrity of the samples during the collection process. In the field, samples will be maintained in the possession of team leaders, or locked inside field vehicles, until relinquished at the field facility. The field facility will be designated as a secured area, accessible by approved personnel only.

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Section Eight

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Section 8

Section 8

Data Reduction, Validation, and Reporting

All samples subject to laboratory analysis will be validated and verified by the laboratory. Upon completion of the laboratory analyses, an independent validation of a portion of the data will then be performed. CDM will consult with EPA to determine what data require validation.

Reduction of laboratory measurements and laboratory reporting of analytical parameters shall be in accordance with the procedures specified for each analytical method (i.e., perform laboratory calculations in accordance with the method-specific procedure). When CLP analytical methods are used, the applicable data assessment/validation procedures defined in the CLP IFB/SOW and CLP Data Validation Functional Guidelines, will be used to establish analytical data quality. Any deviations from the analytical method shall be delineated in a procedure-specific SOP. Any special reporting requirements (e.g., reporting concentrations in soil on a dry or wet weight basis) shall also be delineated in an SOP. All method deviations and reporting or calculation variances will be fully documented by the project lab. Analytical parameters shall be reported in units generally accepted within the industry.

Data Validation and Assessment: General Approach

Data quality and utility depends on many factors, including sampling methods, sample preparation, analytical methods, quality control, and documentation. Subcontractors, such as laboratories or sampling personnel, must be advised of all applicable documentation and procedural requirements. Once the data are assembled, satisfaction of all validation criteria will be documented as listed below. Chemical data must meet criteria of: (1) quantitative statistical significance; (2) custody and document control; and (3) sample representativeness. Physical data include: (1) sampling location, time, and personnel; (2) documentation; and (3) methodologies.

Documentation may be either direct (e.g., listing of dates, names, methodologies, etc.) or by reference to existing documents. Any reference documents will be specifically identified. The precise and retrievable location of nonstandard documents (e.g., in-house procedures manuals, chain-of-custody forms, laboratory reports) will be stated.

To determine the quantitative statistical significance of chemical data, the following items will be documented as appropriate (e.g., with laboratory

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records, laboratory standard operating procedures by reference to an approved SOP manual, or with equipment manufacturer/supplier records).

1. Laboratory/field instrumentation, including calibration data, standard methods and references.
2. Proper sample bottle preparation.
3. Laboratory analysis methods, including reference methods.
4. Laboratory analysis detection limits.
5. Verification of standards using EPA or NBS reference materials.
6. Analysis of laboratory blanks, spikes, duplicates, etc., as specified in this QA/QC Plan and referenced protocols.
7. QC limits shall be consistent with the limits established for EPA's Contract Laboratory Program.
8. Analysis of field duplicates, blanks, and other QC sample types as specified herein and in the Work Plan.

To evaluate the custody and document control for samples and results, the following items will be documented:

1. Field custody noted in field log book or transfer-of-custody documentation for sample collection, handling, and shipment.
2. Laboratory custody documented by transfer-of-custody documentation from either field personnel or shipper.
3. Laboratory custody documented through designated laboratory sample custodian with secured sample storage area.
4. Traceability of sample designation number(s) through entire monitoring system.
5. Maintenance and storage of all field notebooks, laboratory data, and all custody documents.
6. Completion of all forms and log books (indelible ink without alterations except as crossed-out (not erased) and initialed).
7. Identity of sample collector.
8. Dates of sample collection, shipping, and laboratory analysis.

In some cases, the handling of a sample while in the custody of one individual may not be properly documented. In addition, written documentation of transfers of custody between two individuals may be lost. In such cases, it may be necessary to rely on the custodian's verbal testimony that the sample remained secure or that a transfer was made to another individual. If there is any chance that the custodian's testimony will be seen as unreliable, the data produced as a result of that sample may be rejected.

The existence of appropriate and proper documentation associated with a sample's analysis may be judged as acceptable in a court of law; however, the possibility exists that individual testimony as to the proper application of all procedures may be required as well.

To determine sample representativeness, the following items must be checked:

1. Compatibility between field and laboratory measurements or suitable explanation of any discrepancy.
2. Sample preservation technique and holding time.
3. Sample storage within suitable temperature, light, and moisture conditions.
4. Use of proper sample containers (e.g., inert for the parameter(s) of interest).
5. Use of proper sample collection equipment.
6. Use of proper decontamination procedures.
7. Use of proper laboratory preparation techniques (e.g., drying, aliquoting, digestion, extraction).
8. Evaluation of proper sample site selection criteria to provide representativeness.

To evaluate the physical data that support the analytical data, the following items will be documented.

1. Sampling date and time.
2. Sampling team; observation taker and recorder, team leader.
3. Sampling location and physical description (e.g., tilled, rangeland, type of vegetation, monitoring well type, etc.).
4. Sample depth increment for soils.
5. Sample collection techniques.

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6. Field preparation techniques (e.g., compositing, phase separating, etc.).
7. Visual classification of sample using an accepted classification system.
8. A thorough description of the methodology used, and a rationale for the use of that methodology (as included in the project Work Plan, QA/QC Plan, and any Standard Operating Procedures (SOPs).
9. Examination of documentation of record-keeping practices.

QC Documentation

Laboratory data are screened for inclusion and frequency of the necessary QC supporting information (detection limit verification, initial calibration, continuing calibration, reagent blanks, duplicates, spikes, etc.). QC information not included or of insufficient frequency is cause to designate the affected measurement data as questionable or invalid. Requests for reanalysis for additional QC-supporting information can be made at this point.

Corrective Action

QC supporting information is then screened for QC data outside established control limits, and if out-of-control data are discovered, the specified appropriate corrective action is also obtained from the supporting information. Certain out-of-control data without appropriate corrective action are cause to designate the affected measurement data as questionable or invalid. Requests for reanalysis can be made at this point.

As defined in the EPA CLP Statement of Work, automatic corrective action must be taken by CLP laboratories for specified out-of-control instrumental QC checks and for method blanks. Recalibration is required of any instrument until it meets calibration criteria and reanalysis of the associated samples is required for out-of-control Initial and Continuing Calibration Verification Standards and Blanks (ICV/ICB and CCV/CCB), QC Check Samples, GC/MS instrument tunes, the ICP Interference Check (ICS), the Laboratory or Method Control Samples (LCS/MCS), surrogate spike recoveries, and internal standard responses. The laboratory is required to demonstrate that the specified Instrument Detection Limits (IDLs) are attained. Corrective action is required for all types of methods used if any of the above QC measures do not meet criteria as specified in the applicable method or this QA/QC Plan.

It is the responsibility of the Laboratory Manager and the Laboratory QA/QC supervision to implement corrective action when any of the QC measures do not meet the required criteria. The criteria for the implementation of corrective action related to the analysis of laboratory samples is discussed in detail at the end of this section.

Organic analytes found in preparation blanks are required to be less than the contract-required quantitation limits except as specified for certain common laboratory contaminants. Reanalysis is required of any samples associated

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with an out-of-control preparation blank if the reported concentration in the samples of a specific analyte, which was also found in the blank, is less than ten times the amount found in the blank. Air sample preparation (clean canisters) blank data are to be acquired and used to assess the degree of bias, if any, of field sample data values, but the reanalysis requirement applied to other types of preparation blanks will be waived.

For all other QC samples, either a flag or no corrective action is specified. This includes:

Serial dilution

- Holding times
- Common laboratory contaminants found in organic blanks
- Matrix Spikes, duplicates, and matrix spike duplicates
- Graphic Furnace Atomic Absorption (GFAA) duplicate injection (one time reinjection only required)
- GFAA analytical spikes (see CLP decision tree for Method of Standard Additions (MSA) analysis)
- EPA-approved standards

Thus, it is recognized that if a laboratory is operating per protocol and no error or anomaly has occurred during sample preparation and analysis, the only meaningful corrective action is redigestion/re-extraction and reanalysis. The existence of out-of-control, qualified results does not automatically invalidate data. This latter point is repeatedly emphasized in the EPA "Functional Guidelines for Data Validation" and is inherently acknowledged by the very existence of the data validation/flagging guidelines.

The goal to produce the best possible data does not necessarily mean producing data without QC qualifiers. Some qualifiers can provide useful information.

A Laboratory Information Management System (LIMS) will be used to maintain all information pertaining to each sample. Each sample is logged into the system by the Sample Login Supervisor. Information concerning the client, required tests, expected completion date and reporting and invoicing data are entered into the system. The system then generates sample analysis assignment forms which travel to the laboratory with the sample. The results are entered onto this form, which is then returned and the test results, time of analysis and analyst's name is entered into the LIMS database. The only exception to this is that for GC/MS data, only the time and analyst's name are entered; the report is prepared in the GC/MS lab as an enclosure to the final report.

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Upon the completion of all analyses for a sample or group of samples on a work order, the data is validated by the Laboratory Supervisor. No report can be printed until the proper validation release code is entered into the system. This code is available only to the Laboratory Supervisor. Report validation occurs on a daily basis.

Completed reports are printed daily, and are reviewed by the QA/QC Supervisor. The reports are checked for logic and protocol errors and all required QA/QC data is attached to the report. The report is then released to the Document Control Specialist for final preparation and copying. A final check is made of the entire package following which it is mailed or otherwise delivered to the client.

Internal QA/QC checks are an integral part of the laboratory's efforts to provide data of undisputed merit and are done on a routine basis to monitor analytical quality. At least one in ten samples is duplicated and at least one in ten samples is spiked for all tests except for GC/MS analyses. For GC/MS analyses, one sample in twenty is duplicated and spiked. In small sample lots, at least one duplicate and blank is analyzed, even if the sample lot is only one sample. A standard method blank is also run with each lot. Samples for the known addition and the duplicate are chosen at random from the lot being analyzed.

Control charts are prepared for the duplicate and spike sample data to monitor the quality of the data generated in the laboratory over both short and long term time frames. Control charts are useful in that they readily identify data which is outside normal ranges in terms of accuracy and precision. The charts graphically present the information from quality control analyses and indicate when control limits are exceeded and when samples must be re-analyzed after taking corrective action.

Precision is assessed by setting control limits on duplicate analyses at ± 3 standard deviations from the mean, and warning limits are defined by ± 2 standard deviations from the mean. The true value is also plotted on the control chart. The control limit for accuracy is defined as one standard deviation from the mean, and warning limit is set at one half of a standard deviation.

Any problems or concerns of the QA/QC Supervisor are reported immediately to the Laboratory Supervisor and/or Manager who is responsible for insuring that the problems are correctly identified and remedied prior to any further analyses. The QA/QC Supervisor and/or the Laboratory Supervisor and Manager shall take whatever action is required to correct problems, requesting assistance from higher management as necessary.

All tests performed during the period in question must be repeated, and satisfactory results must be obtained on check samples prior to continuation of analyses in areas where problems have been identified.

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Control charts are designed to flag excursions from normal trends before they become problems. These charts are reviewed daily by the QA/QC Supervisor and the Laboratory Supervisor. Data and equipment trends are noted and the operators are informed of the results and possible maintenance or calibration needs. When Warning Limits are exceeded, the Laboratory Supervisor or Manager is required to assess the method and to correct any problems which are found. If the Control Limits are exceeded, the cause must be identified and corrected. The occurrence of the excursion and the corrective action taken are recorded.

PARCC Parameters

Measurement data are reduced and validated in accordance with recognized EPA procedures. These procedures generally include consideration of:

- Representativeness
 - Description of nonconformance with approved sampling and analytical methodology and evaluation of their effects on representativeness
 - Examination of the results of QC blanks for external sample contamination (external contamination may be cause for invalidation)
 - Invalidating nonrepresentative data or identifying data to be classified as questionable; only representative data shall be used in subsequent data reduction and validation activities
- Accuracy
 - Computing percent recoveries for spiked samples
 - Applying Chauvenet's criterion for detecting bad recovery data
 - Determining the range of uncertainty at a given level of confidence
- Precision
 - Examining replicate samples for range of values
 - Determining if sampling error has occurred by comparing scatter
 - Evaluating data on groups of samples that should all have similar composition (by digest group and by sample matrix) by examining the scatter in each group in comparison to the overall scatter (invalid data are discarded)
 - Computing an overall relative standard deviation that is applicable to all the field investigation data from a particular sampling campaign.

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■ **Completeness**

- Computing the fraction of measurement data that remained valid after discarding any invalid data to physical, accuracy, or precision reasons (to be computed as a fraction of total planned and total collected samples)

■ **Comparability**

- Identifying pertinent data characteristics which may limit comparability to other data sets

Data Base QC

Validated data and appurtenant precision and accuracy statements shall be entered into a project data base management system. Duplicate data entry or item-by-item independent entry checks shall be performed as a quality control check of entry accuracy. Computerized data storage should also be routinely verified through the use of a software test program designed to verify the accurate retrieval of data (both sorted and unsorted).

Data Validation and Reduction Package

The entire data validation and reduction package, plus the data base management system file printout shall be transmitted to the client in a format which presents a summarization of the samples collected, results data, and the associated QA/QC which defines the analytical quality of the data.

Field Measurement Data

Validation of data obtained from field measurements (pH, Eh, specific conductivity, dissolved oxygen, temperature, and soil organic vapor) will be performed by the project chemists, geochemists, geologists, or other qualified personnel and the On-Site Coordinator. Validity of all data will be determined by checking calibration procedures utilized in the field as appropriate, evaluating duplicate and control sample analyses, and by comparing the data to previous measurements obtained at the specific site. Large variations (greater than ten percent) will be examined in association with changes in local soil conditions and general trends. Variations in data which cannot be explained will be assigned a lower level of validity and will be used for limited purposes. The project chemists, geologists, or geochemists and the On-Site Coordinator will summarize the data obtained from field measurements and will include this information in field log books.

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Final Reporting and Report Archival

Upon successful completion of the data validation process and assessment of usability of the data, all data generated for the DHA site will be entered into a data base management system (DBMS). Data will be available for analysis by the site manager and other authorized personnel using specific DBMS access codes. Data summaries and results will be submitted.

Copies of all analytical data and/or final reports are retained in the laboratory files and, at the discretion of the laboratory manager, data will be stored on computer disks for a minimum of six months.

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Section 9

Audit Procedures

Internal audits will be the responsibility of the QA/QC officer and will be performed on an as-needed basis. Internal system and performance audits will be conducted during the RI/FS. Additional audits will be performed, if problems are discovered. System audits are qualitative reviews of project activities to check that the overall QA program is functioning properly. Performance audits are quantitative checks on different aspects of internal support or project work, and are appropriate for environmental sampling and analysis activities.

Subsequent to an audit, the QA/QC officer will develop an audit report that summarizes the audit findings, including those areas found to be in non-conformance and the proposed corrective measures. This report will be prepared in memorandum form, submitted to the project manager, and copied to the project file.

The analytical laboratories utilized in the RI/FS will be subject to performance audits in accordance with established CLP protocol. In particular, sufficient advance planning to allow for performance evaluation testing and auditing will be required for non-CLP laboratories.

For split samples analyzed by a CLP Laboratory, the CLP Statement of Work will not include additional audits performed as long as EPA audits have been, or are being, performed at the laboratory. The results of these audits must be determined to be satisfactory and documentation available for project files.

Field performance audits will be conducted as required by EPA or the QA/QC officer. It is understood that the EPA may request an audit of any of the procedures set forth in the RI/FS project documents. A field performance audit will consist of a visit to the field to verify that all QA/QC procedures set forth in the RI/FS QAPP and FSP are being followed. The auditor will compare the sampling, collection, and documentation procedures as stated in the project documents to what is actually being performed in the field. Discrepancies will be noted and the appropriate field personnel will be notified so that corrections can be made immediately. A formal field performance audit report will be produced and delivered to the project manager and field personnel. A copy will also be submitted to the files.

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Section 10

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Section 10

Corrective Action

An important part of the QA program developed for the RI/FS to be conducted at the DHA site is a well defined, effective policy for correcting problems. The QA program operates to prevent problems, but it also serves to identify and correct those that already exist. Usually these problems require either on the spot, immediate corrective action or long term corrective action.

The corrective action system to be used during the RI/FS is designed to identify problems quickly and solve them efficiently. The QA officer is responsible for the direction of this system and receives full support from management for its implementation. The essential corrective action steps for this project are as follows:

- Identify and define the problem;
- Assign responsibility for investigating the problem;
- Determine a corrective action to eliminate the problem;
- Assign and accept responsibility for implementing the corrective action;
- Implement the corrective action;
- Verify that the corrective action has eliminated the problem; and
- Document the problem identified, the corrective action taken and its effectiveness in eliminating the problem.

Corrective action procedures which will be used to resolve deficiencies found during routine activities or QA audits of field, laboratory, or office activities are presented below.

Corrective Action Resulting From Routine Activities

Deficiencies found during normal routine activities will be resolved by implementing corrective action as part of normal operating procedures by staff. Corrective actions of this type will be noted in the field or laboratory notebook. No other formal documentation is necessary unless further corrective action is required. If normal procedures do not solve the problem,

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the staff will document the problem in a formal memorandum addressed to the QA/QC officer and copied to the project file.

Corrective Action Resulting From QA Audits

Deficiencies encountered during a QA audit will be corrected as soon as possible. The project manager is responsible for completion of appropriate corrective action. The procedures used to expedite corrective action will be as follows:

- Auditor verbally notifies the project manager of deficiencies found;
- Project manager institutes corrective action as soon as possible; and
- QA director distributes the audit report properly to team personnel.

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Section 11

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Section 11

Quality Assurance Reports to Management

Reports which present data resulting from field or laboratory measurements during the RI/FS will contain a QA section addressing the quality of the data and its limitations. The QA section will address the following points as appropriate:

- Adherence to the RI/FS FSP, QAPP, and Workplan with an explanation of deviations to these plans;
- Precision, accuracy, and completeness of the data reported, in quantitative terms, as compared with the objectives set for those parameters;
- Representativeness and comparability of data in qualitative terms as compared with objectives set for those parameters;
- Changes and revisions to the documents regarding field work;
- Summary of QC activities, including development of standard operating procedures and QC procedures; and
- Summary of QA activities such as results of performance and/or system audits, description of quality problems found, and description of corrective actions taken.

Measurement reports generated as a result of field or laboratory activities will be reviewed by the QA officer and the project manager.

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Appendix
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APPENDIX A
INORGANIC TARGET ANALYTE LIST

INORGANIC TARGET ANALYTE LIST (TAL)

Analyte	Contract Required Detection Limit ^(1,2) (ug/L)
Aluminum	200
Antimony	60
Arsenic	10
Barium	200
Beryllium	3
Cadmium	3
Calcium	3000
Chromium	10
Cobalt	30
Copper	23
Iron	100
Lead	3
Magnesium	3000
Manganese	13
Mercury	0.2
Nickel	40
Potassium	3000
Selenium	3
Silver	10
Sodium	3000
Thallium	10
Vanadium	30
Zinc	20
Cyanide	10

- (1) Subject to the restrictions specified in the first page of Part C, Section IV of Exhibit D (Alternate Methods - Catastrophic Failure) any analytical method specified in SOW Exhibit D may be utilized as long as the documented instrument or method detection limits meet the Contract Required Detection Limit (CRDL) requirements. Higher detection limits may only be used in the following circumstance:

If the sample concentration exceeds five times the detection limit of the instrument or method in use, the value may be reported even though the instrument or method detection limit may not equal the Contract Required Detection Limit. This is illustrated in the example below:

For lead:

Method in use - ICP

Instrument Detection Limit (IDL) - 40

Sample concentration - 220

Contract Required Detection Limit (CRDL) - 3

**TARGET COMPOUND LIST (TCL) AND
CONTRACT REQUIRED QUANTITATION LIMITS (CRQL)**

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NOTE: The values in these tables are quantitation limits, not absolute detection limits. The amount of material necessary to produce a detector response that can be identified and reliably quantified is greater than that needed to simply be detected above the background noise. The quantitation limits in these tables are set at the concentrations in the sample equivalent to the concentration of the lowest calibration standard analyzed for each analyte.

Specific quantitation limits are highly matrix dependent. The quantitation limits listed herein are provided for guidance and may not always be achievable.

The CRQL values listed on the following pages are based on the analysis of samples according the specifications given in Exhibit D. For each fraction and matrix, a brief synopsis of the sampling handling and analysis steps is given, along with an example calculation for the CRQL value. All CRQL values are rounded to two significant figures. For soil samples, the moisture content of the samples is not considered in these example calculations.

TARGET COMPOUND LIST (TCL) AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL)

Volatiles	CAS Number	Quantitation Limits*			On Column (ng)
		Water ug/L	Low Soil ug/Kg	Med. Soil ug/Kg	
1. Chloromethane	74-87-3	10	10	1200	(50)
2. Bromomethane	74-83-9	10	10	1200	(50)
3. Vinyl Chloride	75-01-4	10	10	1200	(50)
4. Chloroethane	75-00-3	10	10	1200	(50)
5. Methylene Chloride	75-09-2	10	10	1200	(50)
6. Acetone	67-64-1	10	10	1200	(50)
7. Carbon Disulfide	75-15-0	10	10	1200	(50)
8. 1,1-Dichloroethane	75-35-4	10	10	1200	(50)
9. 1,1-Dichloroethane	75-34-3	10	10	1200	(50)
10. 1,2-Dichloroethane (total)	540-59-0	10	10	1200	(50)
11. Chloroform	67-66-3	10	10	1200	(50)
12. 1,2-Dichloroethane	107-06-2	10	10	1200	(50)
13. 2-Butanone	78-93-3	10	10	1200	(50)
14. 1,1,1-Trichloroethane	71-55-6	10	10	1200	(50)
15. Carbon Tetrachloride	56-23-5	10	10	1200	(50)
16. Bromodichloromethane	75-27-4	10	10	1200	(50)
17. 1,2-Dichloropropane	78-87-5	10	10	1200	(50)
18. cis-1,3-Dichloropropene	10061-01-5	10	10	1200	(50)
19. Trichloroethene	79-01-6	10	10	1200	(50)
20. Dibromochloromethane	124-48-1	10	10	1200	(50)
21. 1,1,2-Trichloroethane	79-00-5	10	10	1200	(50)
22. Benzene	71-43-2	10	10	1200	(50)
23. trans-1,3-Dichloropropene	10061-02-6	10	10	1200	(50)
24. Bromoform	75-25-2	10	10	1200	(50)
25. 4-Methyl-2-pentanone	108-10-1	10	10	1200	(50)
26. 2-Hexanone	591-78-6	10	10	1200	(50)
27. Tetrachloroethene	127-18-4	10	10	1200	(50)
28. Toluene	108-88-3	10	10	1200	(50)
29. 1,1,2,2-Tetrachloroethane	79-34-5	10	10	1200	(50)
30. Chlorobenzene	108-90-7	10	10	1200	(50)
31. Ethyl Benzene	100-41-4	10	10	1200	(50)
32. Styrene	100-42-5	10	10	1200	(50)
33. Xylenes (Total)	1330-20-7	10	10	1200	(50)

* Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher.

Note that the CRQL values listed on the preceding page may not be those

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specified in previous CLP Statements of Work. These values are set at concentrations in the sample equivalent to the concentration of the lowest calibration standard specified in Exhibit D VOA. Lower quantitation limits may be achievable for water samples by employing the Statement of Work for Low Concentration Water for Organic Analyses.

VOLATILES

Water Samples

A 5 mL volume of water is purged with an inert gas at ambient temperature. The volatiles are trapped on solid sorbents, and desorbed directly onto the GC/MS. For a sample with compound X at the CRQL of 10 ug/L:

$$(10 \text{ ug/L}) (5 \text{ mL}) (10^{-3} \text{ L/mL}) = 50 \times 10^{-3} \text{ ug} = 50 \text{ ng on the GC column}$$

Low Level Soil/Sediment Samples

A 5 g aliquot of the soil/sediment sample is added to a volume of water in a purge tube, heated, and purged with an inert gas. The volatiles are trapped, and later desorbed directly onto the GC/MS. For a sample with compound X at the CRQL of 10 ug/Kg:

$$(10 \text{ ug/Kg}) (5 \text{ g}) (10^{-3} \text{ Kg/g}) = 50 \times 10^{-3} \text{ ug} = 50 \text{ ng on the GC column}$$

Medium Level Soil/Sediment Samples

A 4 g aliquot of soil/sediment is extracted with 10 mL of methanol, and filtered through glass wool. Only 1 mL of the methanol extract is taken for screening and analysis. Based on the results of a GC/FID screen, an aliquot of the methanol extract is added to 5 mL of reagent water and purged at ambient temperature. The largest aliquot of extract considered in Exhibit D is 100 uL. For a sample with compound X at the CRQL of 1200 ug/Kg:

$$(1200 \text{ ug/Kg}) (4 \text{ g}) (10^{-3} \text{ Kg/g}) = 4800 \times 10^{-3} \text{ ug} = 4800 \text{ ng}$$

This material is contained in the 10 mL methanol extract:

$$(4800 \text{ ng}) / 10 \text{ mL} = 480 \text{ ng/mL}$$

Of which, 100 uL are purged from the reagent water.

$$(480 \text{ ng/mL}) (100 \text{ uL}) (10^{-3} \text{ mL/uL}) = 480 \times 10^{-1} \text{ ng} = 50 \text{ ng on the GC column}$$

Note that for both low and medium soil/sediment samples, while it may affect the purging efficiency, the volume of reagent water used in the purging process does not affect the calculations.

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TARGET COMPOUND LIST (TCL) AND CONTRACT REQUIRED QUANTITATION LIMITS (CRQL)

Semivolatiles	CAS Number	Quantitation Limits*			On Column (ng)
		Water ug/L	Low Soil ug/Kg	Med. Soil ug/Kg	
34. Phenol	108-95-2	10	330	10000	(20)
35. bis(2-Chloroethyl) ether	111-44-4	10	330	10000	(20)
36. 2-Chlorophenol	95-57-8	10	330	10000	(20)
37. 1,3-Dichlorobenzene	341-73-1	10	330	10000	(20)
38. 1,4-Dichlorobenzene	106-46-7	10	330	10000	(20)
39. 1,2-Dichlorobenzene	95-50-1	10	330	10000	(20)
40. 2-Methylphenol	95-48-7	10	330	10000	(20)
41. 2,2'-oxybis (1-Chloropropane)*	108-60-1	10	330	10000	(20)
42. 4-Methylphenol	106-44-5	10	330	10000	(20)
43. N-Nitroso-di-n-propylamine	621-64-7	10	330	10000	(20)
44. Hexachloroethane	67-72-1	10	330	10000	(20)
45. Nitrobenzene	98-95-3	10	330	10000	(20)
46. Isophorone	78-59-1	10	330	10000	(20)
47. 2-Nitrophenol	88-75-5	10	330	10000	(20)
48. 2,4-Dimethylphenol	105-67-9	10	330	10000	(20)
49. bis(2-Chloroethoxy) methane	111-91-1	10	330	10000	(20)
50. 2,4-Dichlorophenol	120-83-2	10	330	10000	(20)
51. 1,2,4-Trichlorobenzene	120-82-1	10	330	10000	(20)
52. Naphthalene	91-20-3	10	330	10000	(20)
53. 4-Chloroaniline	106-47-8	10	330	10000	(20)
54. Hexachlorobutadiene	87-68-3	10	330	10000	(20)
55. 4-Chloro-3-methylphenol	59-50-7	10	330	10000	(20)
56. 2-Methylnaphthalene	91-57-6	10	330	10000	(20)
57. Hexachlorocyclopentadiene	77-47-4	10	330	10000	(20)
58. 2,4,6-Trichlorophenol	88-06-2	10	330	10000	(20)
59. 2,4,5-Trichlorophenol	95-95-4	25	800	25000	(50)
60. 2-Chloronaphthalene	91-58-7	10	330	10000	(20)
61. 2-Nitroaniline	88-74-4	25	800	25000	(50)
62. Dimethylphthalate	131-11-3	10	330	10000	(20)
63. Acenaphthylene	208-96-8	10	330	10000	(20)
64. 2,6-Dinitrotoluene	606-20-2	10	330	10000	(20)
65. 3-Nitroaniline	99-09-2	25	800	25000	(50)
66. Acenaphthene	83-32-9	10	330	10000	(20)
67. 2,4-Dinitrophenol	51-28-5	25	800	25000	(50)
68. 4-Nitrophenol	100-02-7	25	800	25000	(50)

* Previously known by the name bis(2-Chloroisopropyl) ether

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Semi-volatiles	CAS Number	Quantitation Limits*			On Column (ng)
		Water ug/L	Low Soil ug/Kg	Med. Soil ug/Kg	
69. Dibenzofuran	132-64-9	10	330	10000	(20)
70. 2,4-Dinitrotoluene	121-14-2	10	330	10000	(20)
71. Diethylphthalate	84-66-2	10	330	10000	(20)
72. 4-Chlorophenyl-phenyl ether	7005-72-3	10	330	10000	(20)
73. Fluorene	86-73-7	10	330	10000	(20)
74. 4-Nitroaniline	100-01-6	25	800	25000	(50)
75. 4,6-Dinitro-2-methylphenol	534-52-1	25	800	25000	(50)
76. N-nitrosodiphenylamine	86-30-6	10	330	10000	(20)
77. 4-Bromophenyl-phenylether	101-55-3	10	330	10000	(20)
78. Hexachlorobenzene	118-74-1	10	330	10000	(20)
79. Pentachlorophenol	87-86-5	25	800	25000	(50)
80. Phenanthrene	85-01-8	10	330	10000	(20)
81. Anthracene	120-12-7	10	330	10000	(20)
82. Carbazole	86-74-8	10	330	10000	(20)
83. Di-n-butylphthalate	84-74-2	10	330	10000	(20)
84. Fluoranthene	206-44-0	10	330	10000	(20)
85. Pyrene	129-00-0	10	330	10000	(20)
86. Butylbenzylphthalate	85-68-7	10	330	10000	(20)
87. 3,3'-Dichlorobenzidine	91-94-1	10	330	10000	(20)
88. Benzo(a)anthracene	56-55-3	10	330	10000	(20)
89. Chrysene	218-01-9	10	330	10000	(20)
90. bis(2-Ethylhexyl)phthalate	117-81-7	10	330	10000	(20)
91. Di-n-octylphthalate	117-84-0	10	330	10000	(20)
92. Benzo(b)fluoranthene	205-99-2	10	330	10000	(20)
93. Benzo(k)fluoranthene	207-08-9	10	330	10000	(20)
94. Benzo(a)pyrene	50-32-8	10	330	10000	(20)
95. Indeno(1,2,3-cd)pyrene	193-39-5	10	330	10000	(20)
96. Dibenz(a,h)anthracene	53-70-3	10	330	10000	(20)
97. Benzo(g,h,i)perylene	191-24-2	10	330	10000	(20)

* Quantitation limits listed for soil/sediment are based on wet weight. The quantitation limits calculated by the laboratory for soil/sediment, calculated on dry weight basis as required by the contract, will be higher.

SEMIVOLATILES

Water Samples

A 1 L volume of water is extracted in a continuous liquid-liquid extractor with methylene chloride at a pH of approximately 2. This extract is reduced in volume to 1.0 mL, and a 2 μ L volume is injected onto the GC/MS for analysis. For a sample with compound X at the CQL of 10 μ g/L:

(10 μ g/L) (1 L) = 10 μ g in the original extract

When the extract is concentrated, this material is contained in the 1 mL concentrated extract, of which 2 μ L are injected into the instrument:

(10 μ g/mL) (2 mL) (10^{-3} mL/ μ L) = 20×10^{-3} μ g = 20 ng on the GC column

Low Soil Samples

A 30 g soil sample is extracted three times with methylene chloride/acetone at ambient pH by sonication. The extract is reduced in volume to 1.0 mL, and a 2 μ L volume is injected onto the GC/MS for analysis. For a sample with compound X at the CQL of 330 μ g/Kg:

(330 μ g/Kg) (30 g) (10^{-3} Kg/g) = 9900×10^{-3} μ g = 9.9 μ g

When the sample extract is to be subjected to Gel Permeation Chromatography (required) to remove high molecular weight interferences, the volume of the extract is initially reduced to 10 mL. This 10 mL is put through the GPC column, and only 5 mL are collected off the GPC. That 5 mL volume is reduced to 0.5 mL prior to analysis. Therefore:

(9.9 μ g/10 mL) (5 mL) = 4.95 μ g

This material is contained in the 0.5 mL extract, of which 2 μ L are injected into the instrument:

(4.95 μ g/0.5 mL) (2 μ L) (10^{-3} mL/ μ L) = 1.98×10^{-2} μ g) 20 ng on the GC column

Medium Soil Samples

A 1 g soil sample is extracted once with 10 mL of methylene chloride/acetone, which is filtered through glass wool to remove particles of soil. The filtered extract is then subjected to GPC clean up, and only 5 mL of extract are collected after GPC. This extract is reduced in volume to 0.5 mL, of which 2 μ L are injected onto the GC/MS. For a sample with compound X at the CQL of 10,000 μ g/Kg:

(10,000 μ g/Kg) (1g) (10^{-3} Kg/g) = 10 μ g

(continued)

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Semivolatiles, Medium Soil, continued -

This material is contained in the 10 mL extract, of which only 5 mL are collected after GPC:

$(10 \text{ ug}) (5 \text{ mL}/10\text{mL}) = 5 \text{ ug}$

The volume of this extract is reduced to 0.5 mL, of which 2 mL are injected into the instrument:

$(5 \text{ ug}/0.5 \text{ mL}) (2 \text{ mL}) (10^{-3} \text{ mL}/\mu\text{L}) = 20 \times 10^{-3} \text{ ug} = 20 \text{ ng}$ on the GC column

Eight semivolatile compounds are calibrated using only a four point initial calibration, with the lowest standard at 50 ng. Therefore, the CRQL values for these eight compounds are 2.5 times higher for all matrices and levels.

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